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First record of *Tulostoma gracilipes* (*Agaricales, Agaricaceae*) for the Americas

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Abstract — *Tulostoma gracilipes* is reported for the first time in the Americas. Since this species was only known in the type locality of South Africa, this record from Mexico represents the second worldwide. Observations of macro- and microscopic characters for the holotype and Sonoran collection are presented. SEM photomicrographs illustrating spore ornamentation are included.

Key words — *Agaricomycetes*, gasteromycetes, chorology, taxonomy

Introduction

Wright (1987) included 138 taxa in the world monograph of *Tulostoma*. Some species such as *T. gracilipes* and *T. portoricense* J.E. Wright were only known in the type locality given in the monograph. *Tulostoma portoricense* was reported for the second time worldwide (Esqueda et al. 1998), from the mycobiota of Sonora, Mexico. Here we report the first record of *T. gracilipes* from North America, also from Sonora; previously, it was known only from Africa.

Twenty-seven taxa of *Tulostoma* have been registered in Sonora, Mexico (Esqueda et al. 2010). Some of them are broadly distributed: *T. fimbriatum* Fr., *T. squamosum* (J.F. Gmel.) Pers., and *T. pulchellum* Sacc. (Esqueda et al. 2004). Other species have a restricted distribution: *T. floridanum* Lloyd, *T. submembranaceum* G. Moreno et al., and *T. mohavei* Lloyd. This last species was found in the Pinacate and Great Altar Desert Biosphere Reserve (Esqueda et al. 2006).

Tulostoma gracilipes was collected in a protected natural area of Sonora: the Sierra de Mazatán, which is located in central region of Sonora and belongs to the Sonoran Desert Province (28°58'–29°30'N, 109°59'–110°33'W; INEGI 2009). According to the Commission for the Knowledge and Use of Biodiversity in Mexico (CONABIO), this area is an "island" of temperate biodiversity surrounded by the arid landscape of the Sonoran Desert (Arriaga 2000). The predominant vegetation type is subtropical scrub, with oak forest in the highest areas, and semiarid plains with mesquite scrub. This is the first report of a fungus for the Sierra de Mazatán.

Materials and methods

The specimen has been deposited in the macromycetes collection of the Centro de Estudios Superiores del Estado de Sonora (CESUES). Observations of microscopic characters (e.g., spore dimension, including ornamentation) were made using a light microscope to observe material mounted in Hoyer's medium. For ultrastructural studies (e.g., spore ornamentation characteristics), the sample was prepared according to the critical-point-drying method outlined in Moreno et al. (1995) and examined with a Zeiss DSM-950 scanning electron microscope.

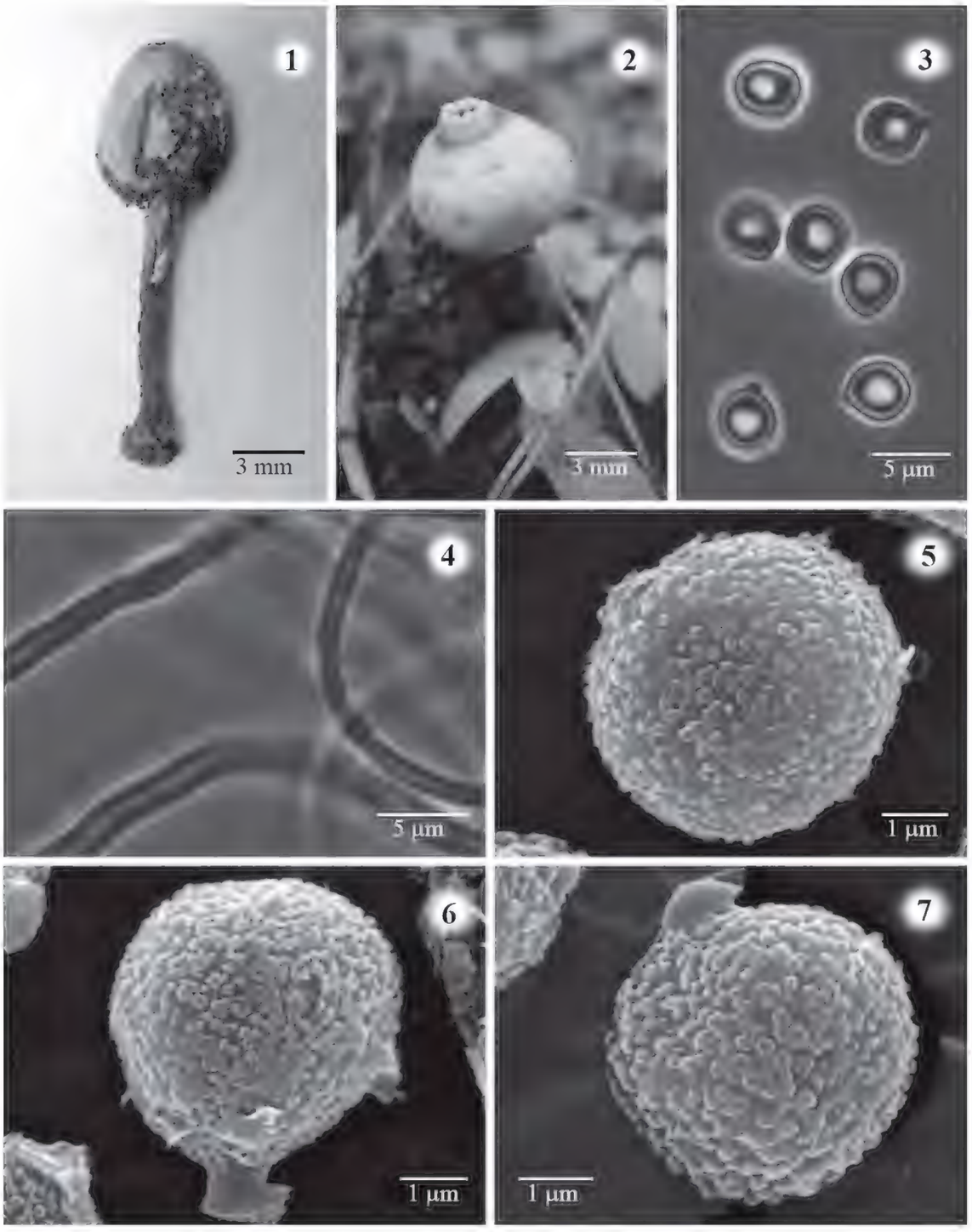
Taxonomy

Tulostoma gracilipes J.E. Wright, Biblthca Mycol. 113: 125 (1987)

Specimens examined — **MÉXICO. Sonora: Municipality of Ures**, leg. C. Piña & A. Gutierrez, 18.XII.2008, CESUES 9100. **SOUTH AFRICA. Northern Cape: Lokenburg**, leg. J.P.H. Acocks 18.934, 18.VIII.1956, PREM 41.614, **Holotype**.

Spore sac 8 × 7 mm. Exoperidium membranous, cream coloured within and dirty cream outside covered by soil grains, persistent mainly at spore sac base (Fig. 1). Endoperidium glabrous, little velvet surface under stereoscopic microscope, white isabelline. Stoma fibrillose-fimbriate, opening less than 1 mm diam., scarcely projecting lip ca. 0.5 mm wide, with a denticulate aspect, surrounded by an easily seen brownish spore deposit simulating a coloured peristome (Fig. 2). Socket shallow, membranous with irregular margins, close to stem. Gleba ochraceous. Stem gracile, yellowish to light brown, longitudinally substriate, 14 × 2 mm, ending basally in a mycelial bulb (Fig. 1).

Spores 3.6–4.9 × 3.1–4.6 µm, yellowish, smooth under LM (Fig. 3), globose, subglobose to ellipsoid, guttulate, thick-walled, hilar appendage 0.5 × 1 µm. Capillitium (Fig. 4) of 1.7–3.8 µm diam., 0.5–1.5 µm thick wall, lumen visible to solid, flexuose, scantily septate and branched, wall conspicuously encrusted with inorganic matter particles. Under SEM spores are verrucose, with small and densely crowded verrucae (Figs. 5–7) that are occasionally joined.



Figs. 1–7. *Tulostoma gracilipes* (CESUES 9100):
1. Basidiome. 2. Spore sac detail. 3. Spores under LM. 4. Capillitium under LM.
5–7. Spores under SEM.

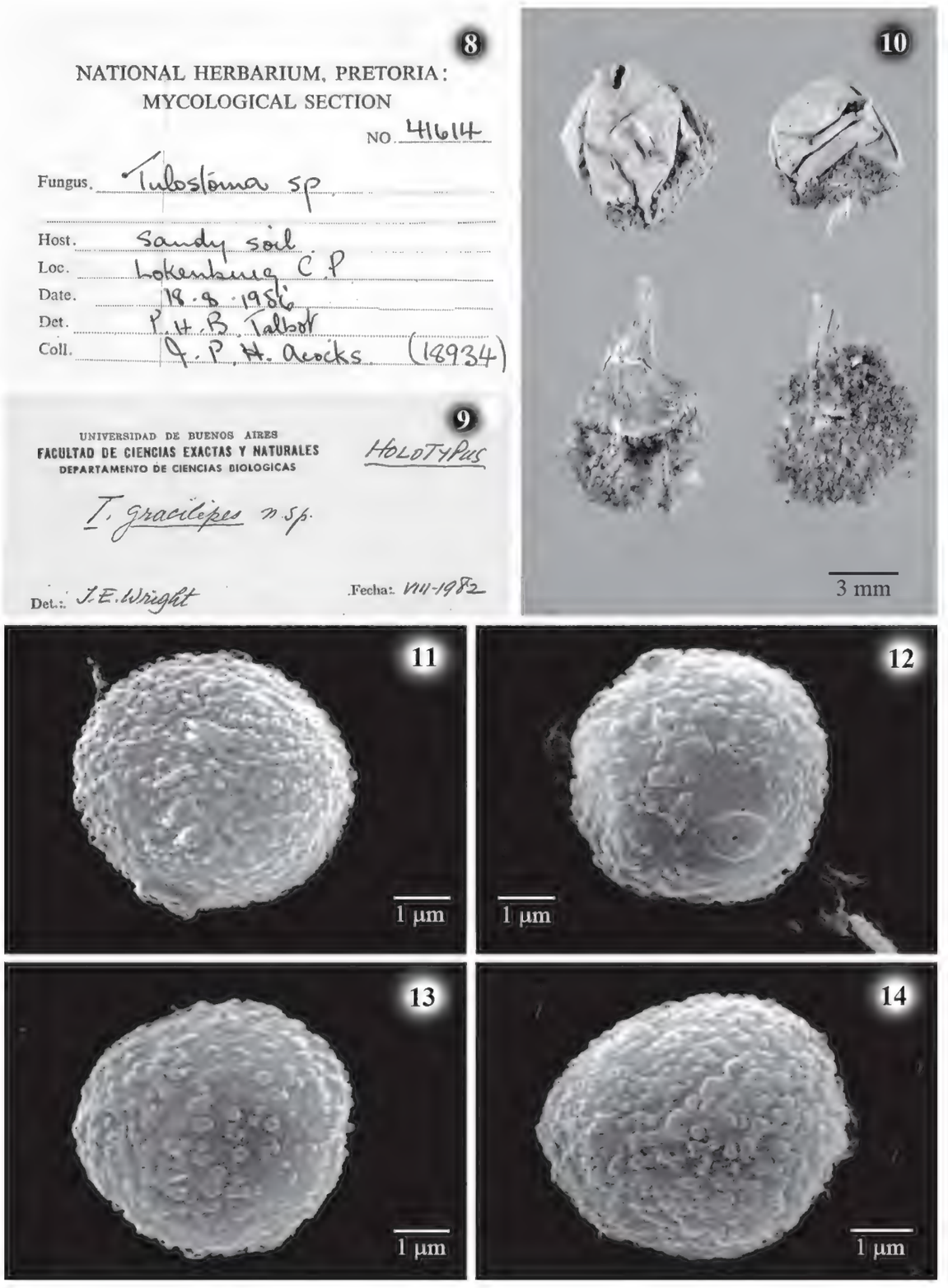
Habitat — Sandy soils, mesquite vegetation, under *Phaulothamnus spinescens* A. Gray (*Achatocarpaceae*) among litter, during autumn.

Observations — The Sonoran material was compared with the type collection of *T. gracilipes* kept in Pretoria (PREM) (Figs. 8–9), which allowed us to confirm our determination. The two basidiomes examined in that type (Fig. 10) had very fragmented stems, but their bases are in good condition. According to the remains, the stems were slender, ca. 1 mm diam., but it was impossible to determine length. In his original description, Wright (1987) describes the stems as up to 25 mm long, which fits well with the illustration included in the monograph (pl. XLIV: 5). He also described the stems as "gracile", a feature reflected in the name of the species. A notable bulbiform thickening (5.5 mm) is also observed at the base of one stem in the type. Stipe bases of both basidiomes are covered by fragile mycelial remains that agglomerate sand grains.

The spore sacs are small (6–7 mm diam.) and well preserved. The endoperidial surface is slightly velvety. Other remarkable features in the type collection are those of the stoma and exoperidium. The stoma is fibrillose-fimbriate, slightly projecting as a denticulate lip, concolorous. The exoperidium persisting on the base of spore sacs is typically membranous, and externally covered by a hyphal layer mixed with sand grains. Spores 4–5.5 µm diam., globose to irregular, yellowish, subsmooth to slightly asperulate under LM. Under SEM spore ornamentation consists of numerous low verrucae, sometimes slightly flattened (Figs. 11–14). Capillitium 4–13 µm diam., uncoloured, thick walled up to 2–3 µm, leaving an irregular lumen, and with scarce uncoloured septa due to their disarticulation.

Tulostoma parvissimum Long & S. Ahmad is closely related but shows an almost indefinite fibrillose stoma and asperulate spores (LM) with larger verrucae. The similar *T. berteroanum* (Lév.) Sacc. has a mouth that is mammose-scutellate to fibrillose when mature and basidiospores with conspicuously larger verrucae under SEM. With small basidiomes and almost identical spores even under the SEM, *T. herteri* Lohwag & Swoboda is a very similar species, which, however, differs notably from *T. gracilipes* in its mammose stoma and hyphal exoperidium (Dios et al. 2004). We could also consider the similarity of the spores of *T. pulchellum* (which also has a membranous exoperidium), but its verrucae are usually more flattened and sometimes united in short crests. Besides, *T. pulchellum* shows mammose-scutellate stoma and more robust basidiomes.

In conclusion, *T. gracilipes* is easily recognized by the combination of the following characters: fibrillose-fimbriate to denticulate stoma, membranous exoperidium, spores that are subsmooth under LM and verrucose under SEM, and a basidiome that is minute. This second world record of *T. gracilipes* allows us to extend significantly the distribution area of the species.



FIGS. 8–14. Holotype of *Tulostoma gracilipes*:
8–9. Labels. 10. Basidiome. 11–14. Spores under SEM.

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